Differences in *Escherichia coli* O157:H7 annual incidence among FoodNet active surveillance sites

Hedberg C, Angulo F, Townes J, Hadler J, Vugia D, Farley M, and the CDC/USDA/FDA Foodborne Diseases Active Surveillance Network

ABSTRACT

To determine the magnitude of *Escherichia coli* O157:H7 infections in five sites across the US, we initiated active laboratory-based surveillance and surveyed laboratories, physicians and the general public regarding factors associated with the diagnosis of *E. coli* O157:H7. In 1996, the combined reported annual incidence rate was 2.9/100,000 population, but varied widely by site (0.6 [GA], 1.1 [CA], 2.3 [CT], 2.6 [OR] 5.5 [MN]. The primary practice factor identified that affected incidence was the laboratory practice of culturing all bloody stools for *E. coli* O157:H7. In CT, OR, and MN >=90% of stools were cultured in laboratories that followed this practice, compared to <70% in CA and GA. Adjusting for physician and laboratory culture practices, estimated incidence rates ranged from 1.4 (GA) to 8.0 (MN) cases/100,OOO population. Less than half of the difference in reported *E. coli* 0157:H7 incidence rates by site were explained by these factors. This suggests the risk of exposure to *E. coli* 0157:H7 may vary by site.

INTRODUCTION

Since it was first recognized as a pathogen in 1982, cases and outbreaks of *Escherichia coli* O157:H7 have been more frequently reported in northern than southern United States (US). This apparent geographic variability in *E. coli* O157:H7 infections has been attributed to differences in surveillance. The actual incidence of *E. coli* O157:H7 infections throughout the US is unknown.

To determine more precisely the burden of *E. coli* O157:H7 and other foodborne diseases in the US. a Foodborne Diseases Active Surveillance Network (FoodNet) was formed. FoodNet is a collaborative effort among the Centers for Disease Control and Prevention, the US Department of Agriculture, the Food and Drug Administration and the state Emerging Infections Program sites (California, Connecticut, Georgia, Minnesota and Oregon).

Table 1. Population Under Surveillance by Site (x 1,000)

CA	CT	GA	MN	OR	Combined
2,003	1,656	2,345	4,375	2,842	13,221

METHODS

Laboratory survey: During the fall of 1995, all laboratories that routinely tested stool specimens for residents of the five sites were identified and surveyed to determine laboratory culture practices for *E. coli* O157:H7 and the number of stool cultures performed during August 1995. Beginning January 1, 1996, these

laboratories were routinely contacted to identify cases.

Physician survey: During January, April, July and October, 1996, a random sample of physicians in primary care and in selected specialties was surveyed to determine their practices with respect to culturing patients with diarrhea.

Population survey: Beginning in March 1996, a monthly random sample of households in each site was surveyed to determine the rate of diarrheal illness in the population and what proportion of persons with diarrhea sought medical care.

The population under surveillance (Table 1) and the number of laboratories, physicians and population surveyed (Table 2) were tabulated by site.

Reported annual incidence rates by site were adjusted to determine if laboratory and physician culture practices could explain observed differences between sites:

(Estimated rate 1 = Reported annual incidence x 1/% stools cultured in laboratories that cultured all bloody stools x 1/% physicians who cultured the last patient seen with bloody diarrhea.)

This rate was further adjusted to estimate the incidence rate for E. coIi O157:H7 cases with bloody diarrhea:
(Estimated incidence of *E. coli* O157:H7 cases with bloody diarrhea estimated rate 1 x % cases with bloody diarrhea x 1I% persons with bloody diarrhea in population survey who reported seeing a physician [28%] x 1 I sensitivity of direct culture on sorbitol-MacConkey agar [SMAC] for persons with *E. coli* O157:H7 infections with bloody diarrhea [71%)

The final adjustment was to estimate the overall incidence rate for *E. coli* O157:H7 infections:

(Estimated overall incidence of *E. coli* O157:H7 = estimated incidence of. E. coii O157:H7 cases with bloody diarrhea x 1 I assumed rate of bloody diarrhea among persons with *E. coli* O157:H7 infections
[50% for low estimate, 25% for high estimate].)

Table 2. Number of Laboratories, Physicians and Population Surveyed by Site, 1996

Number Surveyed	CA	CT	GA	MN	OR	Combined
Laboratories	32	26	33	71	68	230
Physicians	208	293	274	494	515	1,943
Population	1,424	1,473	1,476	1,490	1,440	7,303

RESULTS

The combined reported annual incidence rate of *E. coli* O157:H7 infections for the

five FoodNet sites was 2.9/100,000 population. However, incidence rates varied widely by site from 0.6/100,000 population in GA to 5.5/100,00 population in MN (Table 3).

The percentage of *E. coli* O157:H7 cases with bloody diarrhea and the percentage of cases hospitalized did not vary by site (Table 3). A higher percentage of cases in CT and MN were associated with outbreaks. However, even without these cases, MN still had the highest incidence rate among all sites.

Physician practices for culturing patients with diarrhea did not vary significantly by site (Table 4). Five (28%) of 18 persons with bloody diarrhea in the population survey reported seeing a physician. Only the laboratory practices of culturing all stools and of culturing all bloody stools varied in relation to observed differences inincidence (Table 4). The high proportion of reported cases with bloody diarrhea in all sites suggests that the laboratory practice of culturing all bloody stools for *E. coli* O157 was the primary identified practice factor that affected reporting by site.

Adjusting for physician and laboratory culture practices, estimated incidence rates ranged from 1.4 (GA) to 8.0 {MN) cases/100,000 population (Table 5). The estimated incidence rates for *E. coli* O157:H7 cases with bloody diarrhea ranged from 6.3 (GA) to 32.9 (MN) cases/100,000 population. Estimated overall rates of *E. coli* O157:H7 infections were as high as 25.2 {GA) to 131.6 (MN) cases/100.000 population (Table 5). Based on these rates, the percentage of estimated cases detected through active surveillance ranged from 2.4% (GA) to 4.4% (OR).

Table 3. Number and Characteristics of *E. coli* O157:H7 Infections by Site, 1996

	CA	CT	GA	MN	OR	Combined
Number of Cases	22	38	15	239	73	387
Reported Annual Incidence*	1.1	2.3	0.6	5.5	2.6	2.9
Percentage of Cases with Bloody Diarrhea	80	94	90	82	82	83
Percentage of Cases Hospitalized at Time of Culture	23	21	20	20	19	20
Percentage of Cases Associated with an Outbreak	13	56	0	34	13	30

*per 100,00 population

Table 4. Laboratories and Physician Practices for Stool Culture by Site, 1996

	CA	CT	GA	MN	OR	Combined
All Stools Cultured						
% of laboratories	12	46	21	59	62	49

% of stools	6	69	24	81	70	47
All Bloody Stools Cultures						
% of laboratories	47	87	64	69	85	71
% of stools	69	96	58	90	92	79
Physician Practice						
% who cultured last patient seen with non-bloody diarrhea	30	39	42	44	31	36
% who cultured last patient seen with bloody diarrhea	77	72	79	76	79	78

Table 5. Annual Reported and Estimated Incidence Rates by Site, 1996

	CA	CT	GA	MN	OR	Combined
Reported Annual Incidence[1]	1.1	2.3	0.6	5.5	2.6	2.9
Estimated Rate[2]	2.1	3.3	1.4	8.0	3.5	4.8
Estimated Incidence of *E. coli* O157:H7 Cases with Bloody Diarrhea[3]	8.3	15.7	6.3	32.9	14.6	19.8
Estimated Overall Incidence[4]						
Low Estimate	16.6	31.4	12.6	65.8	29.2	39.6
High Estimate	33.2	62.8	25.2	131.6	58.4	79.2
Percentage of Estimated Cases Detected Through Active surveillance						
Low Estimate	6.6	7.3	4.8	8.3	8.9	7.3
High Estimate	3.3	3.7	2.4	4.2	4.4	3.7

1 - All incidence rates per 100,00 population.

2 - Reported annual incidence rate x 1/% stools cultured in laboratories that culture all bloody stools for *E. coli* O157:H7 x 1/% physicians cultured last patient with bloody diarrhea.

3 - Estimated rate 1 x % cases with bloody diarrhea x 1/% persons with bloody diarrhea xin populations survey who reported seeing a physician (28%) x 1/sensitivity of SMAC for persons with *E. coli* O157:H7 cases with bloody diarrhea (71%).

4 - Low estimate = Estimated incidence of *E. coli* O157:H7 cases with bloody diarrhea x 1/50% rate of bloody diarrhea among persons with *E. coli* O157:H7.

High estimate = Estimated incidence of *E. coli* O157:H7 cases with bloody diarrhea x 1/25% rate of bloody diarrhea among persons with *E. coli* O157:H7.

SUMMARY AND CONCLUSIONS

Results of active surveillance during 1996 demonstrated regional differences in the reported annual incidence rates for *E. coli* O157:H7 among the five FoodNet sites. At the extremes, there was approximately a 9-fold difference in rates. Less than half of this difference was accounted for by differences in the percentage of stools cultured in laboratories that cultured all bloody stools for *E. coli* O157:H7. None of the other identified factors that may affect how likely a person is to be diagnosed with *E. coli* O157:H7 infection appeared to affect reporting by site.

This suggests the risk of exposure to *E. coli* O157:H7 may vary by site. Regional variability has important public health implications; prevention measures for *E. coli* O157:H7 must be developed to address local conditions and practices as well as to national and global distribution.

Suggested citation:

Hedberg C, Angulo F, Townes J, Hadler J, Vugia D, Farley M, and the CDC/USDA/FDA Foodborne Diseases Active Surveillance Network. Differences in *Escherichia coli* O157:H7 annual incidence among FoodNet active surveillance sites. 5th International VTEC Producing Escherichia coli Meeting. Baltimore, MD, July 1997.